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ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

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Report On

PROJECT NO. 36 - TREATMENT OF MESS KITS TO REMOVE GLARE

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ARMORED MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

Project No. 36
426 SPMEA

6 May 1944

1. PROJECT NO. 36 - Treatment of Mess Kits to Remove Glare.

a. Authority - Letter, Headquarters Army Ground Forces, Requirements Section, Washington, D. C., 426 (22 Feb. 44) GNRQT - 11/73965

b. Purpose - To test the suitability of the process described in basic communication for elimination of glare from aluminum mess kits.

2. DISCUSSION:

a. Scope of Test - Tests were limited to a study of the process outlined in basic letter. In this study the tactical desirability of removing glare has not been considered, nor has any search been made for a more suitable process for treating aluminum mess kits.

b. Methods and Procedures:

The suggested method of treatment is described in Par. 1, basic communication: "This process consists of suspending for three minutes the aluminum mess kit in a solution composed of 37% chemically pure Hydrochloric Acid (C.P. HCl) diluted in the proportion of four parts HCl to one part tap water, giving a solution of 26% HCl. The mess kit is then rinsed thoroughly in running tap water."

The details of the methods used are given in the appendix.

c. Factors considered in the tests:

- (1) Is the procedure sufficiently simple and easy to be practical for field use?
- (2) Does the process damage or injure the mess kit?
- (3) How much acid is required to process the mess kits?
- (4) Using hydrochloric acid as the treating agent are other conditions more suitable than those suggested?

3. CONCLUSIONS:

a. The reactions involved in the process are violent; although there is no hazard to the operator if adequate precautions are taken, the process is dangerous if these precautions are neglected.

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b. About two thirds of the aluminum is lost from a mess kit with a three minute dipping in fresh acid of the specified concentration. This reduces seriously the effective life of a mess kit.

c. When used till exhausted, approximately 670 ml of 4 + 1 acid is required for each mess kit. This is equivalent to 1.45 lbs. of concentrated hydrochloric acid. The processing of the mess kits of a company of 200 men would require, therefore, 290 lbs. of concentrated acid.

d. Shorter periods of immersion than three minutes will produce finishes which appear to be equal in glare reduction and durability of the finish produced by the three minute treatment. A 20 to 30 second treatment in acid of the specified concentration can be expected to yield a gain of 5 to 10 fold in economy of both aluminum and acid and will result in only a 7 to 15% loss in weight of the kit.

4. RECOMMENDATIONS:

a. That the suggested process for treatment of aluminum mess kits for the elimination of glare be considered unsatisfactory.

Submitted by:

Norton A. Nelson, Major, SnC

APPROVED

Willard Machle

WILLARD MACHLE,

Colonel, Medical Corps,
Commanding.

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#1 - Appendix

#2 - Tables 1 & 2

#3 - Photograph

APPENDIX

1. Procedure

For some of the tests complete issue mess kits were used, in other cases, test strips 1 x 4 inches were prepared from issue mess kits. The surface was prepared for treatment by a thorough scrubbing with soap and water followed by a thorough rinsing in tap water. In some cases additional preliminary treatment with fat solvents and dilute hydrochloric acid was used without significantly modifying the subsequent response to the anti-glare treatment. The immersion was carried out in large glass jars using glass suspension hooks. When the entire meat can or cover was treated an additional support was necessary to keep the part immersed, since the evolution of hydrogen was so violent that the aluminum would otherwise be floated to the surface.

During the course of treating a series of units in an acid bath, a sequence of events occurs which alter the course and extent of the reaction. Temperature increases; this tends to accelerate the reaction. Trace metals from the aluminum enter the solution, shorten the induction period and tend to accelerate the reaction. Meanwhile consumption of the acid with successive use, results in a progressive slowing of the reaction.

The process, when carried out according to the suggested procedure, results in a violent reaction with the liberation of fumes, hydrogen, and the development of considerable heat. The process is not dangerous if the following precautions are observed; the treatment should be carried out in a vessel considerably larger than the volume of acid used, it should be undertaken only where there is adequate ventilation, and the operator must suitably protect himself from acid spray.

2. Effect of time of immersion and concentration of acid

The influence of the factors of time of immersion and acid concentration on the reduction of glare of aluminum test strips is illustrated in the attached photograph. Three concentrations of acid were used, the specified one of 4 parts concentrated hydrochloric acid to 1 part water, $\frac{1}{2}$ and $\frac{1}{4}$ of this concentration. Time of immersion was varied from 11 seconds to 12 minutes. These tests were made in acid which had been 'seeded' by preliminary solution of a small amount of aluminum. With fresh acid the induction time of the reaction is greater than with used acid, so that an immersion time of 11 seconds with the 4 + 1 acid may give no reaction. (See Table 1). It can be seen in the photograph that satisfactory blackening occurs with only 11 seconds immersion when the 4 + 1 acid is used and with as little as 90 seconds immersion when acid of half this concentration is employed (4 parts conc. HCl + 6 parts water).

Treated test strips were clamped on a board, side by side, in such a way that one half of each strip could be scrubbed without affecting the other half. By frequent shifting of position, all strips received approximately equal treatment. Using this procedure, one half of one side of the strips was

scrubbed with a bristle brush and G. I. soap. After every 100 strokes, the strips were inspected; as judged by this technic, the strips treated for the shorter times appeared to have a finish quite as durable as those immersed for the longer intervals. After 500 strokes, all strips had lost the greater part of the surface coat. Similar treatment with fine steel wool led to the same conclusion as to the relative durability of the surfaces; 30 strokes restored the original sheen of the aluminum.

3. Weight loss by acid treatment

The weight losses (equivalent to reduction in thickness) incurred with the two higher concentrations of acid are given in Table I. Fresh acid was used for each test strip, hence the weight losses with shorter times of immersion were somewhat less than when 'seeded' acid was employed, as mentioned above. Thus, 11 seconds immersion in fresh acid of 4 + 1 concentration resulted in a weight loss of only 0.31%, while with 'seeded' acid a loss of 1.5% occurred in the same length of time.

When intact mess kits were dipped into fresh acid of the specified concentration for three minutes a weight loss of 60% to 70% of the aluminum occurred. The extent of the loss of aluminum with subsequent use of the same acid will depend chiefly on the ratio of acid to aluminum for each dipping. If the ratio of approximately one gallon of acid to one mess kit (cover plus meat can) is used, the second use of the acid will result in approximately 40% loss in weight, and with the third use, about 20% will be lost (See below). As the acid becomes exhausted, the loss of aluminum rapidly decreases. The weight loss corresponds to an equivalent reduction in thickness and consequent weakening of the metal.

4. Exhaustion of acid

Table 2 gives the weight losses of 1" x 4" test strips, (each weighing approximately 8 grams initially) when fresh strips were successively dipped into 150 ml. of 4 + 1 acid. The 6th strip showed a poor surface, the 7th indicated essentially no effect of the acid. On this basis, 150 ml. of 4 + 1 acid would treat (at most) 6, 8-gram units. The issue mess kit (aluminum parts only) weighs about 215 grams. With the same weight-volume ratio, 4 liters (1.06 gals.) of 4 + 1 acid would be required to treat 6 units, or about 670 ml. per unit. This corresponds to 546 ml, 656 gms. or 1.45 lbs. of concentrated hydrochloric acid.

TABLE I

Influence of Time of Immersion
and Acid Concentration on Weight Loss of
Aluminum Test Strips.

Time of Immersion Seconds	WEIGHT LOSS Percent	
	4 HCl + 1 H ₂ O	4 HCl + 6 H ₂ O
11	0.31%	0.01%
22	2.29%	0.01%
45	23.5%	0.05%
90	42.7%	2.6%
180	64.6%	45.9%

TABLE II

Weight Loss of Aluminum Test Strips
With Continued Use of the Same Acid

Three minutes immersion of each strip, in acid
of four parts concentrated HCl to one part water.

Test Strip No.	Weight Loss Percent
1	64.6%
2	37.8%
3	20.2%
4	4.92%
5	3.89%
6	2.81%
7	0.88%

4 VOLS. CONC. HCL
+
1 VOL. H₂O

4 VOLS. CONC. HCL
+
6 VOL. H₂O

4 VOLS. CONC. HCL
+
16 VOL. H₂O

3 MIN.

3 MIN.

12 MIN.

90 SEC.

90 SEC.

9 MIN.

45 SEC.

45 SEC.

6 MIN.

22 SEC.

22 SEC.

3 MIN.

11 SEC.

Effect of time of Immersion and Acid concentration on Glare Reduction

of Aluminum Test Strips

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FORT KNOX, KY.

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